United States
Department of
Agriculture

Forest
Service

Forest
Products
Laboratory

Dividends From Wood Research

Recent Publications

January–June 1989

Explanation and Instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer by the FPL Publications Section between January 1, 1989, and June 30, 1989.

Each publication listed in this brochure is available through at least one of the sources below. For each entry in the brochure, we indicate the primary source for that publication and show you how to obtain a copy:

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail the blank to FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information): Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

Anatomy and Identification

Wood Anatomy of Elm(*Ulmus*) and Hackberry (*Celtis*) Species Native to the United States

Wheeler, E.A.; LaPasha; Miller, R.B.
IAWA Bull. n.s. 10(1): 5–26; 1988.

Available from North Carolina State University, Dept. of Wood and Paper Science, Box 8005, Raleigh, NC 27675–8005. No charge.

The major purpose of this paper is to provide detailed descriptions of the wood anatomy of *Ulmus* and *Celtis* native to the United States. Such information will help with the identification of isolated wood samples, both recent and fossil.

Biodeterioration and Protection

1. Corrosion of Metals in Preservative-Treated Wood

Baker, Andrew J.
In: Hamel, Margaret, ed. Wood protection techniques and the use of treated wood in construction: Proceedings 47358; 1987 October 28–30; Memphis, TN. Madison, WI: Forest Products Research Society; 1988: 99–101.

This paper reports research completed on corrosion of metals in untreated and in preservative-treated wood. Results are given for long-term exposure and by rapid electrochemical testing.

2. Fungal and Termite Resistance of Wood Reacted With Periodic Acid or Sodium Periodate

Chen, George C.; Rowell, Roger M.
Wood and Fiber Sci. 21(2): 163–168; 1989.

The purpose of this research was (1) to determine the resistance of reacted wood to brown- and white-rot fungi and subterranean termites in standard laboratory tests and (2) to study the reactions of periodic acid and sodium periodate with wood.

3. The Use of Naturally Durable Wood Versus Treated Wood

DeGroot, Rodney C.
In: Hamel, Margaret, ed. Wood protection techniques and the use of treated wood in construction: Proceedings 47358; 1987 October 28–30; Memphis, TN. Madison, WI: Forest Products Research Society; 1988: 77–81.

In this paper, the degree of protection needed for various exposures, considerations of health, safety, and the environment are discussed in relation to end use of the wood product. The point is made that these considerations should come before rather than after that of initial cost.

4. Weathering of Wood and Its Control by Water-Repellent Preservatives

Feist, William C.
In: Hamel, Margaret, ed. Wood protection techniques and the use of treated wood in construction: Proceedings 47358; 1987 October 28–30; Memphis, TN. Madison, WI: Forest Products Research Society; 1988: 82–88.

This paper discusses the types of weathering effects on wood and explains finishing methods that can be applied to wood for various results.

5. Comparison of Wood Preservatives in Stake Tests. 1987 Progress Report

Gjovik, L.R.; Gutzmer, D.I.
USDA Forest Serv. Res. Note FPL-RN-02; 1989. 98 p.

This report covers test stake results primarily from Southern Pine sapwood 2 by 4 by 18 in. in size, treated by pressure and nonpressure processes, and installed by the Forest Products Laboratory and cooperators in our decay and termite exposure sites at various times since 1938 at Saucier, MS; Madison, WI; Bogalusa, LA; Lake Charles, LA; Jacksonville, FL; and the Canal Zone, Panama. Also included in the tests at Saucier, MS, are smaller pine stakes and those of treated and untreated plywood, particleboard, modified woods, laminated paper plastic, pine infected with Trichoderma mold, plus other selected wood species such as oak, Douglas-fir, and Engelmann spruce.

6. Chronical of 65 Years of Wood Finishing Research at the Forest Products Laboratory

Gorman, Thomas M.; Feist, William C.
USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–60; 1989. 81 p.

This report outlines the history of the Forest Products Laboratory wood finishing research program, including the perspective of Dr. Frederick L. Browne, the program's leader during the strategic years from 1922–1963. Early research that established the important role of the wood substrate in finish performance and resulted in a classification of the paintability of wood by species, surface texture, ring orientation, and defects is described. Then follows the evaluation of wood finishing research at the Laboratory up to the present time.

7. Proposed Model for the Penetration and Decay of Wood by the Hyphal Sheath of the Brown-Rot Fungus *Postia placenta*

Green, F.; Larsen, M.J.; Murmanis, L.L.; Highley, T.L.
1989 May 21–26; Finland, Document IRG/WP/1391. Stockholm, Sweden; IRG (International Research Group on Wood Preservation) Secretariat; 1989. 16 p.

The results presented in this communication confirm by electron microscopy the existence of extracellular membranous structures of the brown-rot fungus *P. placenta*, and penetration of wood cell-wall layers by these structures. These results also provide a supplemental mechanism to account for distribution of wood decay agents during brown-rot decay.

8. Wettability and Water Repellency of Wood: A Faster, More Convenient Method

Kalnins, Martins A.
In: Kennedy, J.F.; Phillips, G.O.; Williams, P.A., eds. Wood and cellulosics: industrial utilisation, biotechnology, structure and properties. Chichester, West Sussex, England: Ellis Horwood Ltd. Chapter 45; 1987. p. 410–415.

A rapid, reliable procedure for measuring wettability and related properties of wood and wood products is reported. This procedure includes using an automatic surface tension apparatus with a microcomputer for control, data collection, and processing.

9. Hyphal Interaction of *Trichoderma harzianum* and *Trichoderma polysporum* With Wood Decay Fungi

Murmanis, Lidija L.; Highley, Terry L.; Ricard, Jacques
Mater. Org. 23(4): 271–279; 1989.

To gain further insight into the mechanism of parasitism toward wood decay fungi this paper reports (1) hyphal interaction between the *Trichoderma* and wood decay fungi, using scanning electron microscopy and (2) inhibition of decay fungi by filtrates of *T. harzianum* and *T. polysporum* and water extracts from wood permeated with these *Trichoderma*.

10. Chemistry and Microscopy of Wood Decay by Some Higher Ascomycetes

Nilsson, Thomas; Daniel, Geoffrey
Holzforschung. 43(1): 11–18; 1989.

Chemical and microscopic features of wood decay by several ascomycetes in axenic culture are described. The tested ascomycetes caused significant weight losses in birch wood. *Daldinia concentrica* was especially active, causing a weight loss of 62.9 percent after 2 months. While lignin and carbohydrates were both degraded, carbohydrates were preferentially attacked.

11. Spectroscopic Analysis of Southern Pine Treated With Chromated Copper Arsenate. II. Diffuse Reflectance Fourier Transform Infrared Spectroscopy (Drift)

Ostmeyer, Jeffrey G.; Elder, Thomas J.;
Winandy, Jerrold E.
J. Wood Chem. Technol. 9(1): 105–122; 1989.

In this study, several nondestructive, solid-state, spectroscopic techniques were utilized to elucidate the nature of wood/CCA complexes *in situ* in an attempt to understand the influence of CCA treatment on the mechanical properties of Southern Pine.

12. Accumulation of Sulfur Compounds at the Interface of Paint and Wood Following Exposure to Sulfurous Acid

Williams, R. Sam; Kuster, Thomas A.; Spence, John
J. Coatings Technol. 61(769): 19–24; 1989.

Western redcedar (*Thuja plicata*) and Southern Pine (*Pinus* sp.) strips coated on all surfaces with acrylic latex paint were soaked for 10 days at room temperature in pH 2 sulfurous acid. Matched controls were soaked in distilled water. Analysis of cross sections using energy dispersive X-ray analysis showed an accumulation of sulfur compounds at the paint/wood interface on the specimens treated with acid. The sulfur concentration was highest in the wood just below the primer and decreased at a depth of several wood cells. The effect of the sulfur buildup on paint adhesion was not determined in this preliminary study, but it is the focus of continuing work.

Energy

13. Pressurized Downdraft Combustion of Woodchips

Ragland, Kenneth W.; Aerts, Danny J.;
Baker, Andrew J.
In: Research in thermochemical biomass conversion: Proceedings, international conference on research in thermochemical biomass conversion; 1988 April; Phoenix, AZ. New York: Elsevier Science Publishing Co.; 1988: 744–753.

A novel pressurized combustor for a gas turbine has been built and tested using woodchips. Air flows downward through a 23-cm-diameter fuel bed that is supported by alumina gravel. The combustor is operated with high excess air and the reaction zone in the chips is a few centimeters thick. Test results are presented for continuous feed of 2-cm yellow-poplar chips at pressures of 1 to 6 atm and inlet air temperatures of 20°C to 200°C.

14. Current and Projected Wood Energy

Skog, Kenneth
Biologue. April-May: 16–18; 1989.

This paper discusses the models developed to make long-range projections of wood energy use in the United States for residential wood burning and for industrial, commercial, and utility purposes. These models are used to make periodic assessments of the current and long-range demand for and supply of renewable resources, including timber, from forest and rangelands in the United States.

Fuelwood Use in the U.S. Counties

Skog, Kenneth E.; Manthy, Robert S.
Res. Rep. Natural Resources. Feb. 1989. 35 p.

Available from Michigan State University Agricultural Experiment Station, East Lansing, MI 48824. Free to Michigan residents; $2.65 each to nonresidents.

This study explains and determines fuelwood consumption at the county level based on county economic and demographic conditions and identifies U.S. counties where potential fuelwood use problems and benefits are greatest.

15. Biofuels: Production and Potential

Zerbe, John I.
Forum for Appl. Res. and Public Policy: Winter 1988. p. 38–47.

This paper summarizes why the United States needs a comprehensive plan to increase energy research and development that will result in an increase the energy production potential from biomass.

Engineering Properties and Design Criteria

16. Wood Diaphragms: Performance Requirements and Analytical Modeling

Falk, Robert H.; Moody, Russell C.
In: Ang, A.H.-S., ed. Structural design, analysis, and testing: Proceedings of the sessions related to design, analysis, and testing at Structures Congress '89; 1989 May 1–5; San Francisco, CA. New York: American Society of Civil Engineers; 1989: 101–111.

This paper discusses the current performance requirements prescribed by codes and standards for the design of wind-loaded and seismically loaded wood buildings and the status of available analytical models for these structures.

17. Seismic Behavior of Low-Rise Wood-Framed Buildings

Falk, R.H.; Soltis, L.A.
The Shock and Vibration Digest. 20(12): 3–7; December 1988.

This article reviews the performance of wood-frame buildings in recent earthquakes, and summarizes research performed to more fully understand their seismic behavior.

18. Finite Element Modeling of Wood Diaphragms

Falk, Robert H.; Itani, Rafik Y.
J. Struct. Eng. 115(3): 543–559; 1989.

This report describes a nonlinear finite element model formulated to represent the distribution and stiffness of the nails that secure sheathing to framing in a wood diaphragm. When linked with conventional beam and plane stress elements, which represent diaphragm framing and sheathing, respectively, the resulting model can be used to analyze a variety of diaphragms (walls, floors, and ceilings) with different geometry and loading arrangements. Also presented are the results of studies performed with the developed model to determine the effect of varying input parameters—nail properties, nail spacing, and the use of blocking—on floor diaphragms.

Effect of Temperature on Duration of Load of Structural Lumber

Fridley, K.J.; Tang, R.C.; Soltis, Lawrence A.
In: Proceedings, 1988 international conference on timber engineering; 1988 September 19–22; Seattle, WA; 1988: 390–394.

Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705. Cost $2 each, with $5 minimum, plus 10 percent postage and handling.

Select Structural and No. 2 grade Douglas-fir 2 by 4 specimens were tested in bending at 73°F, 100°F, and 130°F; a constant 50 percent relative humidity was maintained. Constant loads based on the 15th percentile of the static strength distribution for each grade were used to load the beams. The results indicate a trend to shorter times to failure at higher temperatures for equal stress ratios. The effect, however, was no more evident in the No. 2 than in the Select Structural. Survival rates were likewise reduced at higher temperatures. All of the effects were felt to be primarily due to temperature since little change in moisture content was observed.

19. Timber Bridge Research by the University of Wisconsin and USDA Forest Service

McCutcheon, William J.; Oliva, Michael G.
In: Bridge Research in Progress, Proceedings of a symposium funded by the National Science Foundation and sponsored by Iowa State University; 1988 September 26–27; Des Moines, IA. Ames, IA: Iowa State University; 1988: 85–88.

The University of Wisconsin–Madison and the USDA Forest Service are cooperating in a comprehensive research program to define the behavior of stress-laminated timber bridges and to develop design procedures for this innovative system. Completed research and work underway are described.

20. Research Progress in Modeling Tensile Strength of Lumber From Localized Slope of Grain

McDonald, K.A.; Cramer, S.M.; Bendtsen, B.A.
In: Proceedings, 6th Nondestructive testing of wood symposium; 1987 September 14–16; Pullman, WA. Pullman, WA: Washington State University; 1988: 113–123.

This report presents the status of continuing research that is aimed at evaluating a method for collecting localized steep grain data around knots using different size scanning heads, converting grain-angle data into a grainline mesh of finite elements, and developing improved finite-element tensile-strength and stiffness prediction models.

Connecting Elements

McLain, Thomas E.; Patton-Mallory, Marcia
In: Load and resistance factor design for engineered wood construction: A pre-standard report. New York: American Society of Civil Engineers. 1988. p. 92–112.

Available from Thomas E. McLain, Virginia Polytechnic Institute and State University, Brooks Forest Products Center, Blacksburg, VA 24061. No charge.

This chapter discusses connecting elements or joints in wood structures that are individually designed and checked to insure safe performance. These include connections using split rings, shear plates, bolts, lag screws, pressed metal plates, nail plates, and any joining mechanism for which appropriate test data are available.

21. Focus on the Future: Structural Forest Products' Development

Moody, Russell C.; Collet, Mary P.
Tree Talk. 9(3): 10–12; Spring 1988.

This paper discusses current trends in structural wood products, examining the forces that led to their development and keep them in the marketplace. It also considers the factors that should influence product development in the future.

22. An Acousto-Ultrasonic Method for Evaluating Decayed Wood

Patton-Mallory, Marcia; Anderson, Kent D.; De Groot, Rodney C.
In: Proceedings, 6th Nondestructive testing of wood symposium; 1987 September 14–16; Pullman, WA. Pullman, WA: Washington State University; 1988: 167–189.

The research reported describes the use of the acousto-ultrasonic method to evaluate the presence of decay in Southern Pine. Preliminary results look promising concerning repeatability. Although no specific conclusions can be drawn about the effect of decayed wood on the acousto-ultrasonic signature, the method presented is a means by which future research can effectively analyze the collected data.

Use of Acoustic Emission in Evaluating Failure Processes of Wood Products

Patton-Mallory, Marcia
In: Proceedings, 1988 International conference on timber engineering; 1988 September 19–22; Seattle, WA; 1988: 596–600.

Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705. Cost $2 each, with $5 minimum, plus 10 percent postage and handling.

Failure processes in brittle materials such as wood release bursts of energy in the form of acoustic emissions. Low-frequency acoustic emissions are what an individual hears as the wood fails. Monitoring acoustic emissions during mechanical tests gives valuable insight into the location and mode of failure. Acoustic emissions are useful for monitoring the progression of fracture zones and damage accumulation. The significance of using acoustic emissions in conjunction with loads and deformations is discussed with examples of how the data provide insight into failure processes.

23. Advances in Wood Engineering and Construction Research

Schaffer, Erwin L.
In: Proceedings, Pacific Rim conference of building officials; 1989 April 9–13; Honolulu, HI. Whittier, CA: International Conference of Building Officials; 1989: 311–329.

This paper discusses some of the wood engineering research and technology transfer activity over the past 10

years at the Forest Products Laboratory. Some of the categories described are (1) truss-framed system, (2) calculated fire endurance, (3) gypsum wallboard protected wood assemblies, (4) roof, floor, and wall composite action, and (5) improved lumber properties and design procedures.

24. Modeling Laterally Loaded Light-Frame Buildings

Schmidt, Richard J.; Moody, Russell C.
J. Struct. Eng. 115(1): 201–217; Jan. 1989.

The purpose of this study was to develop and validate a simple structural analysis model to predict the behavior of light-frame buildings under lateral load. Predicted behavior from the analysis model agreed favorably with results from full-scale tests. The model provides a method for estimating the behavior of light-frame buildings under lateral loading and should lead to realistic shear wall strength and stiffness requirements for both residential and commercial buildings.

25. Condensation Potential in Wood-Frame Walls

Sherwood, Gerald E.
Thermal Insulation: Materials and Systems. ASTM STP 922. F.J. Powell and S.L. Matthews, eds., American Society for Testing and Materials, Philadelphia, PA; 1987: 405–417.

Evaluates the potential detrimental effects of moisture accumulation in wall cavities in both a cold climate and a hot, humid climate with a long air-conditioning season.

26. Light-Frame Wall and Floor Systems: Analysis and Performance

Sherwood, G.; Moody, R.C.
USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-59; 1989. 162 p.

This report describes methods of predicting the performance of light-frame wood structures with emphasis on floor and wall systems. Methods of predicting structural performance, fire safety, and environmental concerns including thermal, moisture, and acoustic performance are addressed in the three major sections.

27. Long-Term Strength of CCA-Treated Lumber

Soltis, Lawrence A.; Winandy, Jerrold E.
Forest Prod. J. 39(5): 64–68; 1989.

The research was limited to No. 1 and No. 2 grades of Southern Pine 2 by 4 lumber, one level of chromated copper arsenate (CCA) Type C preservative treatment, and one redrying temperature (160°F). Treated and untreated (control) specimens were tested for static bending strength and for constant bending stress for 12 weeks.

28. Effects of Treatment and Redrying on Mechanical Properties of Wood

Winandy, Jerrold E.
In: Hamel, Margaret, ed. Wood protection techniques and the use of treated wood in construction: Proceedings 47358; 1987 October 28–30; Memphis, TN. Madison, WI: Forest Products Research Society; 1988: 54–62.

This report reviews the technical literature on the interactive relationship between treatment with preservatives or fire-retardants and post-treatment drying and its effect on wood strength.

Fiber and Particle Products

29. Influence of Some Factors on Curvature of Disk-Cut Flakes

Carll, Charles G.
Forest Prod. J. 39(4): 42–46; 1989.

This study examined curvature of disk-cut flakes in relation to wood species, flake face grain, rake angle, inclination angle, flaker disk speed, and method of flake drying.

30. FPL Spaceboard Development

Hunt, J.F.; Gunderson, D.E.
In: TAPPI proceeding of the 1988 corrugated containers conference; October 24–27; Orlando, FL. Atlanta, GA: TAPPI Press; 1988: 11–17.

The Forest Products Laboratory has developed two processing methods to form, dewater and consolidate, and dry three-dimensional spaceboard sheets. This paper describes the two processing methods; the strength and stiffness values of spaceboard; and the advantages, disadvantages, and development challenges of the product and process.

31. Composite Products Rupture Under Long-Term Loads: A Technology Assessment

Laufenberg, Theodore L.
In: Proceedings, 22d International particle/composite materials symposium; 1988 March 22–24; Pullman, WA. Pullman, WA: Washington State University; 1988: 247–256.

This paper provides a background of information on the creep–rupture phenomena by describing the microscopic mechanisms presumed to control the process, the history of the treatment of creep-rupture in design of wood structures, the models commonly used to describe the creep-rupture time-to-failure behavior, and an overview of the literature for structural particleboards, flakeboards, and plywood.

Pressing of Wood Composite Panels at Moderate Temperature and High Moisture Content

Palardy, Robert D.; Haataja, Bruce A.; Shaler, Stephen M.; Williams, Andrew D.; Laufenberg, Theodore L.
Forest Prod. J. 39(4): 27–32; 1989.

Available from Mr. Robert Palardy, Institute of Wood Research, Michigan Tech University (MTU), Houghton, MI 49931. No charge.

The objectives of this research were to (1) compare the properties of panels pressed at 210°F and 25 percent moisture content to panels pressed at 350°F and 7 percent moisture level and (2) explore the effects of isocyanate

resin level, catalyst level, and pressure on the properties of panels pressed at 210°F and 25 percent moisture content.

32. Dimensional Stability, Decay Resistance, and Mechanical Properties of Veneer-Faced Low-Density Particleboards Made From Acetylated Wood

Rowell, Roger M.; Imamura, Yuji; Kawai, Shuichi; Norimoto, Misato
Wood and Fiber Sci. 21(1): 67–79; 1989.

This paper describes an investigation to produce an acetylated veneer-faced, low-density particleboard that would be strong, aesthetically pleasing, able to hold screws, dimensionally stable, and resistant to decay attack.

33. Dimensional Stability of Bamboo Particleboards Made From Acetylated Particles

Rowell, Roger M.; Norimoto, Misato
Mokuzal Gakkaishi 34(7): 627–629; 1988.

The purpose of this research was (1) to acetylate bamboo particles and to prepare phenol-formaldehyde bonded particleboards and (2) to determine equilibrium moisture contents and rates and extents of water swelling of control and acetylated particleboards.

34. Potential Reductions in Plywood Manufacturing Costs Resulting From Improved Technology

Spelter, Henry; Sleet, George
Forest Prod. J. 39(1): 8–15; 1989.

The purpose of this study was to guide assessments of the plywood industry of the future by develping estimates through computer simulation of the potential cost and productivity impacts of these technologies.

35. Can Chemical Modification Technology Add Value to Your Products?

Youngquist, John; Rowell, Roger M.
In: Proceedings, 22d International particleboard/composite materials symposium; 1988 March 22–24; Pullman, WA. Pullman, WA: Washington State University; 1988: 111–121.

The dimensional stability and susceptibility to biological attack of wood-based composites can be improved dramatically by chemically modifying reactive components of the wood cell wall. Five treatments that alter the physical and/or biological properties of wood are reviewed in general in this paper. Two of the these treatments, chemical cross-linking and the bonding of cell-wall bulking chemicals, are reviewed in detail.

Fire Safety

36. Wood Industry Fire Research Program

Glowinski, Robert W.; LeVan, Susan L.
In: Executive summaries: 42d annual meeting; 1988 June 19–22; Quebec, Canada. Madison, WI: Forest Products Research Society; 1988: 57–59.

This paper outlines an extensive lumber industry fire research program. This program is in response to the future changes in wood design and engineering that will demand new analytical techniques in terms of fire performance. It includes a comprehensive effort in fire modeling, smoke toxicity, and other fire areas.

Fire-Safe Building Products: Research Findings

LeVan, Susan L.
In: Fischer, William C.; Arno, Stephen F., compilers. Protecting people and homes from wildlife in the Interior West: Proceedings of the symposium and workshop; 1987 October 6–8; Missoula, MT. Gen. Tech. Rep. INT–251. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station; 1988: 112–116.

Available from Stephen F. Arno, U.S. Department of Agriculture, Forest Service, Intermountain Research Station, 324 25th Street, Ogden, UT 84401. No charge.

The Forest Products Laboratory (FPL) has served as the national center for wood products research since 1910. The Fire Safety of Wood Products research work unit of FPL is generating new technologies to improve the fire safety of wood-using construction. Our fire research program concentrates on fire growth, fire endurance, and fire retardants. This paper discusses the research activities in each of these areas.

37. Choosing and Applying Fire-Retardant-Treated Plywood and Lumber for Roof Designs

LeVan, Susan; Collet, Mary
USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–62; 1989. 11 p.

Fire-retardant-treated (FRT) plywood used as roof sheathing has exhibited strength degradation in some situations. The cause appears to be certain fire retardant chemicals that are activated under environmental conditions of high temperature and moisture content. This report describes how fire retardants are made, how they work, and what causes strength degradation of FRT wood. Guidelines for selecting and using FRT wood and precautions to follow when designing roof systems with FRT plywood are presented.

38. Heat Release Measurement of Wood Products Using the Ohio State University Apparatus

Tran, Hao C.
In: Proceedings of the 13th international conference on fire safety; 1988 January 11–15; Millbrae, CA. Sunnyvale, CA: Product Safety Corp.; Vol. 13: 298–311; 1988.

An Ohio State University (OSU) heat release apparatus was used to evaluate heat release properties of wood. Particleboard, Douglas-fir plywood, and red oak were tested in a vertical orientation under different heat flux levels and under piloted and unpiloted conditions in an OSU heat release chamber. The chamber was instrumented to obtain heat release data by both thermal and oxygen consumption methods simultaneously. The heat release rates obtained by the thermal method are consistently lower than those obtained by the oxygen consumption method. A method to reconcile the differences by using a blank holder was tried with success.

39. Rates of Heat and Smoke Release of Wood in an Ohio State University Calorimeter

Tran, Hao C.
Fire and Mater. 12: 143–151; 1988.

In this study, the Ohio State University apparatus was instrumented to obtain heat release rate values using the oxygen method and the standard thermal method simultaneously. Heat and smoke release rates of some wood products were obtained at different heating fluxes and under different ignition conditions.

General

Effect of Moisture on the Acoustical Properties of Wood

Sasaki, Takayuki; Norimoto, Misato;
Yamada, Tadashi; Rowell, Roger M.
Mokuzai Gakkaishi 34(10): 794-803; 1988.

Available from Roger Rowell, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705–2398. No charge.

This article is written in Japanese with an English abstract.

40. Potentiometer Testing

Welch, Craig; Laufenberg, Theodore L.
Measurements & Control. 22(6): 140–143; 1988.

The objective of this study was to determine which potentiometer should be used in a large, long-term test program requiring over 600 transducers for deflection measurement.

The Heterogeneous Character of the Dilute Acid Hydrolysis of Crystalline Cellulose

Wood, Barry F.; Conner, Anthony H.;
Hill, Charles G. Jr.
J. Appl. Polym. Sci. 37: 1373–1394; 1989.

Available from Department of Chemical Engineering, University of Wisconsin-Madison, WI 53706. No charge.

The end-attack model proposed by Sharples [*Trans. Faraday Soc.*, 53, 1003 (1957)] for the dilute acid hydrolysis of crystalline cellulose was tested using the results from the size-exclusion chromatographic analysis of samples of crystalline cellulose I and cellulose II hydrolyzed in 6.1 N HCl at 107°C.

Microbial and Biochemical Technology

Manganese, Mn-Dependent Peroxidases, and the Biodegradation of Lignin

Forrester, Ian T.; Grabski, Anthony C.;
Burgess, Richard R.; Leatham, Gary F.
Biochem. Biophys. Res. Commun. 157(3): 992–999; 1988.

Available from U.S. Biotechnology Center, 1710 University Avenue, Madison, WI 53705. No charge.

Manganese and Mn-dependent peroxidases have been implicated in the enzymatic degradation of lignin. However, the specific role of manganese is uncertain. This paper reports the novel observation that in the absence of enzyme, suitably chelated Mn^{3+} is a ligninolytic agent capable of oxidizing veratryl alcohol, lignin model compounds, and lignin. Also demonstrated is the unexpected effect of reducing agents which stimulate the oxidations by Mn^{3+}. The stimulation is apparently through the production of a reduced oxygen species likely to be superoxide. These observations provide a fresh insight into the process of lignin biodegration.

41. Physical, Chemical, and Biochemical Considerations in the Biological Degradation of Wood

Jeffries, T.W.
In: Kennedy, J.F.; Phillips, G.O.; Williams, P.A., eds. Wood and cellulosics: industrial utilisation, biotechnology, structure and properties. Chichester, West Suissex, England: Ellis Horwood Ltd. Chapter 24; 1987. p. 213–230.

This paper resynthesizes past knowledge with a few major recent findings and relates tissue and polymer structure of wood to mechanisms for its biological and biochemical degradation.

42. Regulation of Alcohol Dehydrogenase in Xylose and Glucose Fermentations

Jeffries, Thomas W.; Cullen, Daniel;
Alexander, Michael A.
Chimica Oggi.: 23–27; 1988.

Alcohol dehydrogenase (ADH) has been extensively studied at the biochemical, genetic, and molecular biological levels in *Saccharomyces cerevisiae* and other organisms, but it has only recently become a focal point for study in the yeast xylose fermentation. Xylose, occurring as xylan in the lignocellulosics of angiosperms, can be recovered readily from renewable lignocellulosics and converted to useful fermentation products. There are major differences between xylose- and glucose-fermenting yeasts, both in general metabolic capabilities and in regulatory patterns. This paper reports on molecular biological studies with *S. cerevisiae*, biochemical studies with xylose-fermenting yeasts, and metabolic engineering studies with bacteria indicating that the regulation of ADH activity, and particularly its constitutive expression, is critical in achieving a rapid fermentation.

43. Synthetic ^{14}C-Labeled Lignins

Kirk, T. Kent; Brunow, Gösta
In: Wood, Willis A.; Kellogg, Scott T., eds. Methods in enzymology—Biomass, part b, lignin, pectin, and chitin. San Diego, CA: Academic Press, Inc.; 1988: 65–73. Vol. 161.

This paper describes the synthesis of ^{14}C-labeled coniferyl alcohol, with the label in the β- and γ-carbons of the side chain, in the methoxyl carbon, or uniformly in the aromatic ring carbons. These coniferyl alcohols permit the synthesis of synthetic gymnosperm-type lignins. These lignins should suffice for most investigations. However, the end of this section summarizes methods that have been, or could be, used for synthesizing labeled sinapyl and ρ-coumaryl alcohols, if it is desired to prepare homopolymers from these other precursors or copolymers derived from mixtures.

44. Lignin Determination

Kirk, T. Kent; Obst, John R.
In: Wood, Willis A.; Kellogg, Scott T., eds. Methods in enzymology—Biomass, part b, lignin, pectin, and chitin. San Diego, CA: Academic Press, Inc.; 1988: 87–101. Vol. 161.

This chapter summarizes the most widely used methods for determining lignin. Researchers should always include known lignin samples or samples of known lignin content as controls in any procedure. The procedures that are described were developed for plant tissues, but should be adaptable to isolated lignins in reaction mixtures.

45. Extracellular Acid Phosphatases of *Lentinula edodes*: Correlation of Increased Activity With Fruit Body Development and Enzyme Localization, Substrates, Effectors, and Stability

Leatham, Gary F.; Hasselkus, Jane C.
Mush. J. Tropics. 9: 55–78; 1989.

Rather than investigate a single enzyme, the purpose of this initial study was to partially characterize the range of extracellular acid phosphatase activities present in crude mycelial extracts of *L. edodes*. This overview is needed to help determine their *in vivo* function(s). Reported are the temporal correlation of increased activity with culture development, as well as the tissue, cellular localization, and enzymatic characteristics of the activity in extracts made from different tissues, cellular localization, and enzymatic characteristics of the activity in extracts made from different tissues.

46. Isolation of Lignin

Obst, John R.; Kirk, T. Kent
In: Wood, Willis A.; Kellogg, Scott T., eds. Methods in enzymology—Biomass, part b, lignin, pectin, and chitin. San Diego, CA: Academic Press, Inc.; 1988: 3–12. Vol. 161.

Significant gains have recently been made in understanding the biochemistry of the microbial degradation of lignin. Further advances will be facilitated through studies using isolated lignins. This chapter presents some of the most useful methods for lignin isolation.

Lignin Distribution in Wood Delignified by White-Rot Fungi: X-Ray Microanalysis of Decayed Wood Treated With Bromine

Otjen, Lewis; Blanchette, Robert A.
Holzforschung. 42: 281–288; 1988.

Available from Robert Blanchette, University of Minnesota, St. Paul, MN. No charge.

This paper explains how a technique to characterize the differences between the chemically defined and visually defined types of selective delignification caused by white-rot fungi.

47. Lignin Peroxidase of *Phanerochaete chrysosporium*

Tien, Ming; Kirk, T. Kent
In: Wood, Willis A.; Kellogg, Scott T., eds. Methods in enzymology—Biomass, part b, lignin, pectin, and chitin. San Diego, CA: Academic Press, Inc.; 1988: 238–249. Vol. 161.

This paper describes the production of ligninase in shallow stationary cultures and in agitated cultures. The stationary cultures give somewhat more reliable and reproducible results than the agitated cultures.

Mycology

48. *Polyporus lowei*, a New Species From the Great Lakes Region

Burdsall, Harold H. Jr.; Lombard, Frances F.
Memoirs of the New York Botanical Garden. 49: 147–151; 1989.

In 1974 and 1976, the senior author found a species of *Polyporus* with large basidiocarps fruiting on dead sugar maple (*Acer saccharum* Marsh.). Two other specimens of the same species were found in the University of Michigan herbarium. Attempts to identify the species proved futile. Therefore, this paper describes it as a new species.

49. Carbohydrate-Degrading Complex of the Brown-Rot Fungus *Postia placenta*: Purification of β-1,4-Xylanase

Green, Frederick III; Clausen, Carol A.; Micales, Jessie A.; Highley, Terry L.; Wolter, Karl E.
An extremely stable extracellular glycoprotein, β-1,4-xylanase, was isolated both by ethanol precipitation and by ultrafiltration from a crude, water-soluble extract of sweetgum (*Liquidambar styraciflua*) decayed by the brown-rot fungus *Postia placenta*. The enzyme was further purified and separated from the glycosidase enzymes on Fractogel 55.

50. A Comparison of Dinitrogen Fixation Rates in Wood Litter Decayed by White-Rot and Brown-Rot Fungi

Jurgensen, M.F.; Larsen, M.J.; Wolosiewicz, M.; Harvey, A.E.
Plant and Soil. 115: 117–122; 1989.

Nitrogen fixation rates, as estimated by the acetylene reduction technique, were determined in conifer wood litter being decayed by brown- and white-rot fungi. Average ethylene production rates were significantly higher in white-rotted wood than in brown-rotted wood. Greater nitrogen additions from nitrogen-fixing bacteria may be a factor in the more rapid white-rot decay of hardwood litter, as compared to the slower brown-rot decay of conifer wood.

51. Taxonomy and Nomenclature of *Phellinus weiri* in North America

Larsen, Michael J.; Lombard, Frances F.
In: Morrison, D.J., ed. Proceedings of the 7th international conference on root and butt rots; 1988 August 9–16; Vernon and Victoria, BC, Canada. International Union of Forestry Research Organisations (IUFRO) Working Party S2.06.01. Victoria, BC, Canada: Forestry Canada, Pacific Forestry Centre; 1989: 573–578.

This communication provides additional evidence for the existence of two recognizable taxa, focusing on various aspects of the life cycles of the two.

52. Physiological Characteristics of A Non-Degradative Isolate of Postia (≡*Poria) placenta*

Micales, Jessie A.; Highley, Terry L.
Mycologia. 81(2): 205–215; 1989.

The brown-rot fungus *Postia placenta* (Fr.) M. J. Lars. et Lomb. (≡*Poria placenta* Fr.) is an economically important degrader of wood and wood products. This fungus and other wood-decay fungi are currently controlled by applying broad-spectrum biocides, many of which are receiving restricted use because of their extreme toxicity. A better understanding of the physiological mechanisms of decay may assist in developing specific metabolic controls that would target the decay fungus but would not affect other organisms.

Processing of Wood Products

53. Kiln Drying 4/4 American Elm and Sweetgum Lumber With a Combination of Conventional-Temperature and High-Temperature Schedules

Boone, R. Sidney
USDA Forest Serv. Res. Pap. FPL–RP–491; 1989. 15 p.

A group of studies was started at the Forest Products Laboratory to better understand the responses of red maple, American elm, and sweetgum to increasing the dry-bulb temperature to 230°F at various levels of moisture content. This study presents the results of the studies on 4/4 American elm and sweetgum lumber.

54. A New Method for Separating Diffusion Coefficient and Surface Emission Coefficient

Liu, Jen Y.
Wood and Fiber Sci. 21(2): 133–141; 1989.

An analytical procedure has been developed to separate the diffusion and surface emission coefficients in Newman's solution of the unsteady-state diffusion equation from a single lumber-drying curve. Previous methods required two to four drying curves corresponding to as many specimen thicknesses to achieve the same purpose. The new procedure reduces the experimental effort by 50 percent and more. Numerical examples are included to demonstrate the application of the new technique.

55. How to Save Face (Veneer) With the Lab's MVP Dryer

Loehnertz, Stephen P.
Wood Based Panels North America. October 1988: 32–33.

This paper describes how a continuous press dryer called the FPL Modular Veneer Press dryer dries veneer. It also gives a comparison of drying veneer using the MVP compared to conventional jet dryers used in industry.

56. Can the Cell Wall Be Stabilized?

Rowell, Roger M.
In: Suchsland, Otto, ed. Wood science seminar 1: Stabilization of the wood cell wall; 1987 December 15–16; East Lansing, MI. East Lansing, MI: Michigan State University; 1988: 53–63.

Areas are discussed of what needs to be stabilized in wood: (1) the matrix the cell wall polymers are in and (2) the cell wall polymers themselves.

57. The Impact of Technological Change on Projections of Costs and Recoveries in Wood Products Processing

Spelter, Henry; Durbak, Irene; Skog, Kenneth; Howard, James; Ince, Peter
In: Healthy forests, healthy world. Proceedings, 1988 Society of American Foresters national convention; 1988 October 16–19; Rochester, NY. Bethesda, MD: Society of American Foresters: 332–336.

In 1988, the Forest Products Laboratory reviewed the status of current and prospective technologies available to the forest products industries, from timber harvesting to end product uses. This paper focuses on the changes in technology occurring in processing of timber into lumber, panels, and paper.

Pulp, Paper, and Packaging

58. A New Approach for the Production of Cellulose Acetate: Acetylation of Mechanical Pulp With Subsequent Isolation of Cellulose Acetate by Differential Solubility

Barkalow, D.G.; Rowell, R.M.; Young, R.A.
J. Appl. Polym. Sci. 37: 1009–1018; 1989.

An uninvestigated approach to the production of cellulose acetate, the acetylation of whole wood pulp with subsequent isolation of the cellulose derivative by differential solubility, is described. The mechanical pulp used was produced by refining aspen wood chips with a disc refiner. Two conventional acetylation techniques, the fibrous and solution process, were employed to acetylate all components of the pulp.

59. Dimensional Stability of Paper: Papermaking Methods and Stabilization of Cell Walls

Caulfield, Daniel F.
In: Suchsland, Otto, ed. Wood science seminar 1: Stabilization of the wood cell wall; 1987 December 15–16; East Lansing, MI. East Lansing, MI: Michigan State University, 1988: 87–98.

This paper is a discussion on the dimensional stability of paper that shows the measure of control of dimensional stability that can be achieved using conventional papermaking practices. It points out the need for additional research in this area because dimensional instability not only reduces paper and paperboard performance, but the problems of dimensional instability and poor wet stiffness of paper and paperboard limits their acceptance as engineered materials of construction.

60. Paper Testing and Strength Characteristics

Caulfield, D.F.; Gunderson, D.E.
In: TAPPI proceedings of the 1988 paper preservation symposium; 1988 October 19–21; Washington, DC. Atlanta, GA: TAPPI Press; 1988: 31–40.

This paper looks at four strength properties of paper and the TAPPI test methods that are typically used to evaluate these properties. It discusses how environmental conditions, especially relative humidity, affect test results, and how accelerated aging coupled with strength testing provides a means of estimating permanence. Also, it mentions recent developments of mechanical testing that incorporates a greater degree of environmental control for more accurately appraising of performance characteristics of paper under actual use conditions.

Modeling Fiber Flow in the Pulp and Paper Industry

Durbak, Irene
In: Abt, Robert C., ed. Forest resource economics: past, present, and future: Proceedings of the 1988 Southern forest economics workshop; 1988 May 4–6; Orlando, FL. Gainesville, FL: University of Florida; 1988: 117–126.

Available from Robert Abt, Department of Forestry, University of Florida, 118 Newins-Ziegler Hall, Gainesville, FL 32611. No charge.

A computer spreadsheet model was developed that links softwood and hardwood pulpwood, major grades of wood pulp and recycled fiber, other natural fibers, and product output in the U.S. pulp and paper industry. It calculates fiber use by product grade and region, for 1986 and 2000 to 2040. This model can be used to simulate different assumptions about production and consumption levels, production processes, technological developments, and regional distribution.

61. Modeling Technology Change and Fiber Consumption in the U.S. Pulp and Paper Industry

Durbak, Irene; Howard, James L.; Ince, Peter J.; Lange, William J.
In: Seppala, Risto, ed. Forest sector analysis revisited. Proceedings, International symposium; 1988 July 25–29; Kerimaki, Finland. Helsinki: Finnish Forest Research Institute; 1989: 40–50.

This paper describes the Pulpwood Model, highlights some preliminary projections, and discusses parts of the model needing further development.

62. Factors Affecting Wet Strength of Press-Dried Paperboard

Horn, Richard A.
Tappi Journal. 72(6): 85–89; 1989.

The objectives of this study were to (a) find a test method that would quantify the moisture resistance of press-dried linerboard and (b) investigate the effect of press-dry process variables on moisture resistance of linerboard made from high-yield hardwood kraft pulps.

Modeling Technology Change and Fiber Consumption in the U.S. Pulp and Paper Industry

Howard, James L.; Ince, Peter J.; Durbak, Irene; Lange, William J.
In: Abt, Robert C., ed. Forest resource economics: past, present, and future: Proceedings of the 1988 Southern forest economics workshop; 1988 May 4–6; Orlando, FL. Gainesville, FL: University of Florida; 1988: 211–219.

Available from Robert Abt, Department of Forestry, University of Florida, 118 Newins-Ziegler Hall, Gainesville, FL 32611. No charge.

The USDA Forest Service Pulpwood Model developed at the Forest Products Laboratory enables researchers to make 50-year projections of pulpwood consumption and paper and paperboard production in North America. These projections will be used by the Forest Service in its 1989 Assessment of the U.S. demand and supply of timber. In the model, changes are introduced in product and process technology, based on a survey of likely developments in pulp, paper, and related technologies. For each grade of paper and paperboard, the model projects by region, the most cost-effective combination of technological processes, as well as equilibrium levels of production and fiber consumption to satisfy demand. Projections indicate substantial growth to the year 2040 in total U.S. paper and paperboard production, and increasing hardwood pulpwood consumption.

63. Increased Disk Separator Throughput

Klungness, John H.; Evans, James W.
In: TAPPI Notes—1989 Contaminant problems and strategies in wastepaper recycling seminar, 1989 April 24–26; Madison, WI. Atlanta, GA: TAPPI Press; 1989: 121–124.

At present, no single satisfactory industrial process exists for recovering fiber from recycling mill tailing streams. This study was undertaken to increase the throughput of a disk separator with a 152-mm-diameter disk from the present 0.23 metric ton per day at optimum conditions to the 2 to 3 metric tons per day required for use on an industrial scale for applications such as fiber recovery of tailing streams.

64. Image Analysis for Measuring Adhesive Contaminants in Pulp

Klungness, John H.; Fernandez, Luis E.; Plantinga, Pamela L.
Tappi J. 72(1): 89–93; 1989.

An image analysis method was used to measure a hot-melt adhesive (HMA) contaminant in simulated old-corrugated-container pulp. The effects of handsheet preparation variables and light sensitivity were determined. Weight concentrations of HMA estimated by the image analysis and visual methods were also compared to the HMA concentration obtained by solvent extraction.

65. Search for Lignin Condensation Reactions With Modern NMR Techniques

Landucci, Lawrence L.
In: Hemingway, Richard W.; Conner, Anthony H.; Branham, Susan J., eds. Adhesives from renewable resources: ACS symposium series 385; 1987 August 30–

September 4; New Orleans. Washington, DC: American Chemical Society; 1989: 27–42. Chapter 3.

This study is a preliminary effort to detect and characterize structures in the lignin polymer that result from condensation reactions during alkaline treatment.

66. Assignment of Carbon and Proton Chemical Shifts of Methyl Neoabietate by One- and Two-Dimensional NMR Spectroscopy

Landucci, Lawrence L.; Zinkel, Duane F.
Holzforschung. 43(2): 105–110; 1989.

The ^{13}C and ^{1}H NMR spectra of the methyl esters of neoabietic acid, a diterpene resin acid, are interpreted. All of the ^{13}C and ^{1}H chemical shifts were assigned by a combination of one-dimensional methods such as conventional proton decoupling. NOE difference, and DEPT; and two-dimensional experiments such as short- and long-range CH correlation.

67. History of FPL Cold Soda CMP Process: 1950–Present

McGovern, J.N.; Springer, E.L.
In: TAPPI proceedings of the 1988 pulping conference; 1988 October 30–November 2; New Orleans, LA. Atlanta, GA: TAPPI Press; 1988: 641–648. Book 3.

The purposes of this report are (1) to record the circumstances of the origin and development of the FPL cold soda CMP process; (2) to note the growth and decline of commercial cold soda pulping in the U.S.; (3) to point out the short time for transfer of the experimental technology into mill practice; (4) to discuss the nature and mechanism of the cold soda process from new experimental information; and (5) to review recent literature on the process.

68. Delignification of Aspen Wood Using Hydrogen Peroxide and Peroxymonosulfate

Springer, Edward L.
In: TAPPI Notes—1989 Contaminant problems and strategies in wastepaper recycling seminar, 1989 April 24–26; Madison, WI. Atlanta, GA: TAPPI Press; 1989: 125–128.

The purpose of this work was to determine whether acidic hydrogen peroxide could delignify aspen wood and, if not, whether peroxymonosulfuric acid made by reacting hydrogen peroxide and sulfuric acid could delignify the wood. Aspen wood (*Populus tremuloides* Michx.) was chosen for study because it is easily delignified.

69. Progress in Bleaching Pulps With the Sulfite-Air System

Springer, Edward L.; McSweeny, James D.
In: TAPPI proceedings of the 1988 pulping conference; 1988 October 30–November 2; New Orleans, LA. Atlanta, GA: TAPPI Press; 1988: 741–745. Book 3.

This research is part of an effort to replace chlorine, hypochlorite, and chlorine dioxide in the final stages of bleaching with a suitable nonchlorine oxidizing agent. Objectives were to optimize the conditions for sulfite-air bleaching of a partially delignified pulp and to demonstrate that oxygen-delignified hardwood and softwood pulps can be effectively bleached.

70. Fate of Resin Acids in Kraft Pulping

Walter, Jocelyn; Han, James S.; Zinkel, Duane F.
Naval Stores Review. 99(1): 17–19; 1989.

The object of this study was to further evaluate the effect of the pulping process on the recoverability of resin acids and to define the mechanisms responsible for any losses.

71. Effect of Kraft Black Liquor and NSSC Spent Liquor Components on Polymeric Additive Performance

Wegner, Theodore H.
In: TAPPI Notes—1989 Contaminant problems and strategies in wastepaper recycling seminar; 1989 April 24–26; Madison, WI. Atlanta, GA: TAPPI Press; 1989: 91–96.

In this report, the components of kraft black liquor—precipitated lignin and saponfied extractives (simulated by use of sodium oleate)—and fractionated neutral sulfite semichemical (NSSC) spent liquor were investigated for their effects on the performance of cationic polyacrylamide used as a drainage or fines-retention aid.

Timber Requirements and Economics

72. National Measures of Forest Productivity for Timber

Ince, Peter J.; Fedkiw, John; Dickerhoof, H. Edward; Kaiser, H. Fred
USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-61; 1989. 13 p.

This report presents national measures of forest productivity for timber. These measures reveal trends in the relationship between quantity of timber produced by forests and the quantity of forest resources employed in timber production. Timber production is measured by net annual growth of timber and annual timber removal. Measures of timber productivity include annual growth per acre and indexes of growth/inventory and removal/inventory. Information is presented separately for softwood and hardwood timber.

A Conceptual Approach for the Business and Economic Evaluation of A New Product Concept: FPL Spaceboard

Marcin, Thomas C.
In: Abt, Robert C., ed. Forest resource economics: past, present, and future: Proceedings of the 1988 Southern forest economics workshop; 1988 May 4–6; Orlando, FL. Gainesville, FL: University of Florida; 1988: 127–142.

Available from Robert Abt, Department of Forestry, University of Florida, 118 Newins-Ziegler Hall, Gainesville, FL 32611. No charge.

This paper presents a conceptual approach for assessing new product technology with respect to research objectives and economic feasibility and applies this approach to

assessing specific product concepts based on spaceboard technology.

73. Moving Toward a New Systems Paradigm for Forest Sector Modeling and Analysis

Marcin, Thomas C.
In: Seppala, Risto, ed. Forest sector analysis revisited: Proceedings of an international symposium; 1988 July 25–29; Kerimaki, Finland. Helsinki: Finnish Forest Research Institute; 1989: 110–121.

This paper suggests some alterations in the conceptual framework for evaluation of the forest resource system using systems analysis techniques, and it emphasizes technology change as an endogenous component.

74. A Systems Analysis Approach to Economic Feasibility Analysis for Forest Products Utilization

Marcin, Thomas C.
In: The 1988 symposium on systems analysis for forest resources; 1988 March 29–April 1; Pacific Grove, CA. Gen. Tech. Rep. INT–161. Fort Collins, CO: U.S. Department of Agriculture, Forest Service; Rocky Mountain Forest and Range Experiment Station: 251–259.

This is a conceptual paper rather than a procedural paper. An expanded view of systems analysis is presented in an attempt to broaden thinking about what feasibility analysis means and how evaluation of forest products utilization might be improved, which is what system analysis is all about.

75. Strategic Planning for Forest Resource Utilization Research

Marcin, Thomas C.
In: Healthy forests, healthy world. Proceedings, 1988 Society of American Foresters national convention; 1988 October 16–19; Rochester, NY. Bethesda, MD: Society of American Foresters; 1988: 300–304.

This paper is about strategic thinking and not formal planning. It is a conceptual or philosophical paper, and as such does not provide a prescription for actual forest resources planning.

Wood Used in New Residential Construction in the United States: A Forest Service End-Use Survey

McKeever, David B.
In: Abt, Robert C., ed. Forest resource economics: past, present, and future: Proceedings of the 1988 Southern forest economics workshop; 1988 May 4–6; Orlando, FL. Gainesville, FL: University of Florida; 1988: 155–161.

Available from Robert Abt, Department of Forestry, University of Florida, 118 Newins-Ziegler Hall, Gainesville, FL 32611. No charge.

The Forest Service and the Wood Products Promotion Council are currently engaged in a study to estimate the types and quantities of wood products used to construct new single- and multifamily residences in the United States. The study consists of two independent surveys: one to determine the incidence of building practice types employed in 1986 and the other to determine the amounts of wood products required for each type of building practice. Estimates of total wood products used by type of product, region, house size, number of stories, and foundation type will be developed.

76. Session IVB: Forecasting and Facilitating Adoption of Technological Innovations

Skog, Kenneth; Ince, Peter; Spelter, Henry; Durbak, Irene; Howard, James
In: Executive summaries: 42d annual meeting; 1988 June 19–22; Quebec, Canada. Madison, WI: Forest Products Research Society; 1988: 65–67.

This paper displays preliminary projections of product recovery and processing costs for softwood lumber, panels, paper, and paperboard and explains the tehnological reasons for these trends.

Technology Forecasting for the Softwood Lumber and Wood Panel Industries

Skog, Kenneth; Spelter, Henry
In: Abt, Robert C., ed. Forest resource economics: past, present, and future: Proceedings of the 1988 Southern forest economics workshop; 1988 May 4–6; Orlando, FL. Gainesville, FL: University of Florida; 1988: 143–153.

Available from Robert Abt, Department of Forestry, University of Florida, 118 Newins-Ziegler Hall, Gainesville, FL 32611. No charge.

This paper discusses the method used to project trends in softwood lumber and panel-making technologies through 2040 for the 1989 USDA Forest Service timber assessment. Preliminary projections of product recovery factors and processing costs that are to be used in the Timber Assessment Market Model are given.

77. Simulating Plywood Economics for Improved Decision Making

Spelter, Henry
Plywood & Panel World. Feb.-Mar.: 28–30; 1989.

This report describes a mill simulation program called PLYMAP that provides a way to test the effects of new technology on the rotary-peeled plywood industry. The system can also be used to answer several process-related questions, such as the effect of changing the rate of material flows and the effect of installing new machinery.

Tropical Wood Utilization

78. Performance of A Solar/Wood Energy Kiln in Tropical Latitudes

Simpson, William T.; Tschernitz, John L.
Forest Prod. J. 39(1): 23–30; January 1989.

This paper reports observations on the energy efficiency of the kiln, its durability, and its overall ability to dry lumber.

79. A Glucose, Urea, and Phenol-Based Adhesive for Bonding Wood

Christiansen, Alfred W.
In: Hemingway, Richard W.; Conner, Anthony H.; Branham, Susan J., eds. Adhesives from renewable resources: ACS symposium serries 385; 1987 August 30–September 4; New Orleans. Washington, DC: American Chemical Society; 1989: 370–386. Chapter 26.

This chapter reports work on two aspects of this adhesive system: (1) tests on the strength of panels bonded with phenol/carbohydrate/urea/formaldehyde adhesive compositions outside the ranges previously reported and (2) analysis of chemical reactions in this resin system.

80. Carbohydrate Modified Phenol-Formaldehyde Resins

Conner, Anthony H.
In: Proceedings, 22d International particleboard/composite materials symposium; 1988 March 22–24; Pullman, WA. Pullman, WA: Washington State University; 1988: 133–149.

This report describes research on using carbohydrates to partially replace phenol-formaldehyde resin used to bond durable wood products.

81. Carbohydrates in Adhesives: Introduction and Historical Perspective

Conner, Anthony H.
In: Hemingway, Richard W.; Conner, Anthony H.; Branham Susan J., eds. Adhesives from renewable resources: ACS symposium series 385; 1987 August 30–September 4; New Orleans. Washington, DC: American Chemical Society; 1989: 271–288. Chapter 20.

A broad overview of how carbohydrate polymers, oligomers, monomers, and degradation products have been utilized in and for adhesives is given.

82. Soybean-Based Wood Adhesives

Conner, Anthony H.
In: Johnson, Lawrence A., ed. New technologies for value-added products from protein and co-products: Proceedings of the 80th annual meeting of the American Oil Chemists' Society Protein and Co-Products Division; 1989 May 3–6; Cincinnati, OH. St. Louis, MO: American Soybean Association; 1989. 14 p.

This paper reviews the use of soybean-based adhesives in the forest products industry. In particular, it draws heavily on the use of soybean adhesives in the plywood industry. The plywood industry is a major consumer of adhesives within the forest products industry and was historically the major consumer of soybean adhesives.

83. Carbohydrate-Modified Phenol-Formaldehyde Resins Formulated at Neutral Conditions

Conner, Anthony H.; Lorenz, Linda F.; River, Bryan H.
In: Hemingway, Richard W.; Conner, Anthony H.; Branham, Susan J., eds. Adhesives from renewable resources: ACS symposium series 385; 1987 August 30–September 4; New Orleans. Washington, DC: American Chemical Society; 1989: 355–369. Chapter 25.

In this study, up to about 50 percent of the phenol-formaldehyde was replaced with carbohydrates and the modified resins used to bond wood veneer panels. The carbohydrate modified resins were formulated and cured under neutral conditions.

84. Durable Wood Adhesives From Kraft Lignin

Gillespie, Robert H.
In: Hemingway, Richard W.; Conner, Anthony H.; Branham, Susan J., eds. Adhesives from renewable resources: ACS symposium series 385; 1987 August 30–September 4; New Orleans. Washington, DC: American Chemical Society; 1989: 110-125. Chapter 9.

This chapter describes the evaluation of formulation variables to help define the useful range of ingredient concentrations, practical conditions for achieving the hydroxymethylation reaction, and the acidification conditions required for producing good working properties in the adhesive so that reproducible high-quality bonds could be formed.

85. Economics of Accelerated Bonding

Harpole, George B.; Geimer, Robert L.
In: Kennedy, J.F.; Phillips, G.O.; Williams, P.A., eds. Wood and cellulosics: industrial and properties. Chichester, West Sussex, England: Ellis Horwood Ltd; 1987: 521–527. Chapter 5.

In this paper, computerized simulations of structural flakeboard manufacture are used to assess manufacturing costs for a diversity of processing assumptions related to binders.

86. The Reversion Reactions of D-Glucose During the Hydrolysis of Cellulose With Dilute Sulfuric Acid

Helm, Richard F.; Conner, Anthony H.
Carbohydr. Res. 185: 249–260; 1989.

A previously reported reduction–permethylation technique was utilized to provide reaction-product samples that were amenable to quantitative analysis by gas–liquid chromatography. The results from the analysis of the reversion reactions are the subject of this report.

87. Opportunities for Future Development of Adhesives From Renewable Resources

Hemingway, Richard W.; Conner, Anthony H.
In: Hemingway, Richard W.; Conner, Anthony H.; Branham, Susan J., eds. Adhesives from renewable resources: ACS symposium series 385; 1987 August 30–September 4; New Orleans. Washington, DC: American Chemical Society; 1989: 487–494. Chapter 34.

The book focuses on industry utilization of adhesives from renewable resources derived from trees. This chapter presents a summary of information reported in the other

chapters of this book and how it relates to the needs of industry, the obstacles in using new adhesive technology, and the future opportunities for adhesives based on renewable resources.

Improving the Fatigue Resistance of Adhesive Joints in Laminated Wood Structures

Laufenberg, Theodore L.; River, Bryan H.; Murmanis, Lidija L.; Christiansen, Alfred W.
U.S. Department of Energy, Conservation and Renewable Energy, Wind/Ocean Technology Division DOE/NASA/0015–1, NASA CR–182165; 1988.

Available from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. Order No. N8912675. Printed $15.95. Microfiche $6.95.

The premature fatigue failure of a laminated wood/epoxy test beam containing a cross-section finger joint was the subject of a multidisciplinary investigation at the Forest Products Laboratory. Primary objectives of this research were to identify the failure mechanisms that occurred during the finger joint test and to provide avenues for general improvements in the design and fabrication of adhesive joints in laminated-wood structures.

88. Factors Affecting the Strength of Block-Shear Specimens

Okkonen, E. Arnold; River, Bryan H.
Forest Prod. J. 39(1): 43–50; January 1989.

This report compares the effects of shear tool design and specimen form, shape, size, and grain direction on the apparent strength of solid wood and adhesively bonded block-shear specimens of four different species.

89. Adhesives

Vick, Charles B.
In: Wilkes, Joseph A.; Packard, Robert T., ed. Encyclopedia of Architecture: Design, Engineering and Construction; 1988: 91–103.

This article addresses the amount of adhesive used in the construction industry to assemble building materials at construction sites and in small shops. Mechanisms of adhesive bonding and the natures of bonding surfaces and polymers that are common to most adhesive applications are also discussed.

Special Item

BOF Sawing Simulation Analysis Routine—User's Guide, IMPROVE System, Version 01/06/89

January 1989, 126 p.

Lumber Product Size Analysis Routine—User's Guide, IMPROVE System, Version 05/01/89

May 1989, 92 p.

State and Private Forestry and Forest Products Laboratory

User's guides for two routines within the Lumber Manufacturing Program of the IMPROVE System are available. IMPROVE (Integrated Mill Production and Recovery Options for Value and Efficiency) is a package of easily understood and effective tools for measuring and improving the efficiency of sawmills, veneer mills, and plywood plants. Its data collection procedures and computer software combine several successful, existing, recovery improvement programs with the latest in technological and research developments.

BOF Sawing Simulation Analysis Routine—User's Guide helps mill owners and operators assess their mills' current level of lumber conversion efficiency and improve management control in dimension sawmills. By modeling 20 variables in the breakdown process, this routine provides information such as position of the opening face for both log and cant, Lumber Recovery Factor and lumber tally for individual logs; rough green target size; sizing and wane allowances; and summary tables on total number of pieces produced and total board foot tally. This information helps the user maximize lumber recovery for either volume or value and helps control the amount of wane left on pieces. *BOF Sawing Simulation Analysis* is a companion routine to the Log Analysis Routine (Log Processing Program).

Lumber Product Size Analysis—User's Guide assesses the performance of any breakdown system that determines lumber dimension. Two techniques, analysis of variance and quality control charts, record the variability in product size and determine when the manufacturing process is not performing at its capability. The information gained through this analysis can provide the basis for setting up a statistical quality control system.

Information on software and documentation availability may be obtained by writing Stan Lunstrum, State & Private Forestry, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, Wisconsin 53705–2398.

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